(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
22 March 2001 (22.03.2001)

PCT

(10) International Publication Number
WO 01/20736 A1

(51) International Patent Classification[7]: H02B 13/035

(21) International Application Number: PCT/EP00/08842

(22) International Filing Date:
4 September 2000 (04.09.2000)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
MI99A001923 15 September 1999 (15.09.1999) IT

(71) Applicant *(for all designated States except US)*: **ABB RICERCA S.P.A.** [IT/IT]; Viale Edison, 50, I-20099 Sesto San Giovanni (IT).

(72) Inventors; and

(75) Inventors/Applicants *(for US only)*: **PIAZZA, Costante** [IT/IT]; Via Marzagalli, 18, I-26900 Lodi (IT). **SFONDRINI, Libero** [IT/IT]; Viale IV Novembre, 25, I-26900 Lodi (IT). **SCIACCA, Aldo** [IT/IT]; Via 1° Maggio, 7/B, I-20097 San Donato Milanese (IT).

(74) Agent: **GIAVARINI, Francesco**; ABB Ricerca S.p.A., Viale Edison, 50, I-20099 Sesto San Giovanni (IT).

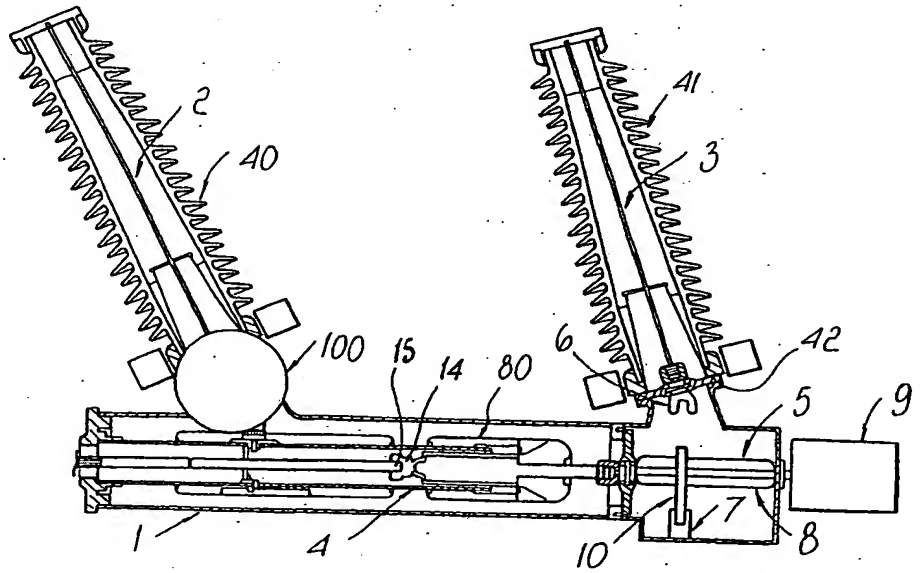
(81) Designated States *(national)*: AL, AU, BG, BR, CA, CN, CZ, HR, HU, IL, IN, JP, KP, KR, MX, NO, NZ, PL, SI, TR, UA, US, YU.

(84) Designated States *(regional)*: ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

Published:
— *With international search report.*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: GAS-INSULATED SWITCHGEAR DEVICE



(57) Abstract: A gas-insulated switchgear device which has a first bushing which accommodates a first terminal, a second bushing which accommodates a second terminal, a first enclosure which contains an interruption unit, and at least one first disconnection unit which has a first fixed contact electrically connected to the interruption unit and a second fixed contact at ground voltage, a first moving contact which is electrically connected to the first terminal and can be coupled to the first and second fixed contacts, the moving contact being fixed to a rotary operating element and rotating rigidly therewith, the fixed contacts that can be coupled to the moving contact lying on the rotation plane of the moving contact.

WO 01/20736 A1

second moving contact 10 is constituted by a blade which has a circular sector-shaped profile and is keyed on the shaft 8. The moving contact 10 and the third and fourth fixed contacts 6 and 7 are arranged so that the ends of said fixed contacts lie on the plane traced by the rotation of the end of the moving contact 10. In this case, the disconnection operation occurs by turning the shaft 8; accordingly, the moving contact 10 rigidly coupled thereto couples to the fixed contact 6 or 7, thus providing the line or ground connection of the output terminal 3, respectively. In Figure 1, the moving contact 10 is coupled to the fixed contact 7; the ground connection is therefore closed, while the output connection is open.

According to an alternative embodiment, not shown in the figure, it is possible to have two moving contacts which are fixed to the shaft 8, each being able to couple to a corresponding fixed contact. In this case, the fixed contact 6 lies on the rotation plane of one of the two moving contacts that can be coupled thereto, while the fixed contact 7 lies on the rotation plane of the other moving contact that can be coupled thereto. Furthermore, the two moving contacts are fixed to the shaft 8 in a relative angular position by virtue of which they cannot be simultaneously coupled to the fixed contacts 6 and 7. In this manner, by virtue of the rotation of the shaft 8, one obtains for example uncoupling between the fixed contact 6 and the first moving contact, followed by coupling between the fixed contact 7 and the second moving contact, thus providing ground disconnection. It is possible to proceed in the same manner when one wishes to open the ground disconnection contact and close the line contact.

A gas-insulated switchgear device for a two-bar system is now described with reference to Figure 2. As previously described, the device of Figure 2 comprises an enclosure 1 which contains a disconnection unit 5 and an interruption unit 4, and contains an insulating gas, a first bushing 40 which accommodates an input terminal 2, and a second bushing 41 which accommodates a first output terminal

11. Between the bushing 40 and the enclosure 1 there is a disconnection unit 100; the device furthermore comprises a third bushing 43 which accommodates a second output terminal 13. In this case, the disconnection unit 5 comprises a third fixed contact 21 which is connected to the output terminal 11, a fourth fixed contact 22 at ground voltage, and a fifth fixed contact 23 which is connected to the second output terminal 13. As in Figure 1, the fixed contact 22 is connected to the enclosure 1 which is at ground voltage. The disconnection unit 5 comprises a rotating shaft 8 which is moved by actuation elements which are schematically represented by the device 9, which can be for example an appropriately controlled electric motor.

A second moving contact 31, a third moving contact 32 and a fourth moving contact 33, electrically connected to the interruption unit 4, are fixed to the shaft 8 and rotate rigidly therewith. In the embodiment of Figure 2, the moving contacts 31, 32 and 33 are constituted by blades which have a circular sector-like profile and are keyed to the shaft 8. The moving contacts 31, 32, 33 and the fixed contacts 21, 22, 23 are arranged so that for each pair of contacts (21, 31), (22, 32) and (23, 33) the fixed contact lies on the rotation plane of the corresponding moving contact. Furthermore, the moving contacts 31, 32 and 33 are fixed to the shaft 8 with such an angular arrangement that the moving contact 32 cannot be coupled to the fixed contact 22 when the moving contact 31 and/or the moving contact 33 are coupled to the corresponding fixed contacts 21 and 23. Switching for disconnection on the output terminal side occurs by turning the shaft 8; accordingly, the moving contacts 31, 32 and 33 rigidly coupled thereto couple to the respective fixed contacts 21, 22 and 23. In Figure 2, the moving contact 32 is coupled to the fixed contact 22, while the moving contacts 31 and 33 are uncoupled from the respective fixed contacts 21 and 23; the ground connection is therefore closed, while the output connections are open.

The operating principle is shown schematically in Figures 5a-5d, in which the moving contacts are constituted by blades which are keyed to the shaft 8.

With reference to Figure 5a, a situation is shown in which the moving contact 32 is coupled to the corresponding fixed contact 22, while the moving contacts 31 and 33 are uncoupled from the corresponding fixed contacts. By turning the shaft 8 in the direction of the arrow, the ground contact is opened and then the moving contact 31 couples to the fixed contact 21, closing the connection toward the output terminal 11 (Figure 5b). By again turning the shaft 8 in the same direction, the moving contact 33 couples to the fixed contact 33 before uncoupling occurs between the contacts 21 and 31. In this manner, the connection toward the output terminal 13 is closed while the connection toward the terminal 11 simultaneously remains closed (Figure 5c). If the rotation of the shaft 8 is continued, it is possible to separate the contact 31 from the contact 21, opening the connection toward the terminal 11 and keeping closed the connection toward the terminal 13 (Figure 5d). It is furthermore possible to perform a switching operation, not shown, in which all the moving contacts are uncoupled from the corresponding fixed contacts so that the output terminals are disconnected without being grounded.

According to an alternative embodiment, not shown, the second disconnection unit 5 comprises just two moving contacts which are fixed to the shaft 8. The fixed ground contact 22 and one of the other two fixed contacts, for example the fixed contact 21, lie on the rotation plane of said moving contact, which can be coupled alternately to the fixed contact 21 or to the fixed contact 22; the third fixed contact 23 lies on the rotation plane of the other moving contact and can be coupled thereto. The two moving contacts are fixed to the shaft 8 with a mutual angular arrangement by virtue of which they cannot be simultaneously coupled to the contacts 22 and 23, while their relative angular position is such that they can be simultaneously coupled to the fixed contacts 21 and 23.

As previously indicated, in both embodiments of Figures 1 and 2, the switchgear device according to the invention comprises an interruption unit 4 which has an interruption chamber which accommodates a fixed contact 14 and a moving contact 15, the longitudinal axis of the interruption chamber being substantially aligned with the rotation axis of the second operating element 8. In this case, the opening/closure switching of the interruption unit 4 is performed by means of a translatory motion of the moving contact of the interruption unit along the longitudinal axis of the device, while disconnection on the output terminal side occurs by rotation of the moving contacts of the disconnection unit 5 about said longitudinal axis.

According to a particular embodiment, not shown, the operating element of the disconnection unit 5 is constituted by the enclosure 80 of the interruption chamber. In this case, the moving contacts of the second disconnection unit 5 are keyed to the outer surface of the interruption chamber, which can rotate with respect to the enclosure 1 of the device. The movement is applied by actuation elements, for example an appropriately controlled electric motor. The mutual arrangement of the fixed contacts and of the moving contacts is similar to the one shown in Figures 1 or 2, depending on whether a single- or two-bar system is provided. By using this technical solution, the device according to the invention is particularly compact, since the space occupied by the disconnection unit 5 is distributed inside the enclosure 1 along the interruption chamber.

As mentioned, the disconnection elements are moved by virtue of suitable actuation means, preferably constituted by a controlled electric motor. In particular, it has been found that the use of a servomotor, both for the first disconnection unit 100 and for the second disconnection unit 5, as well as for the movement of the moving contacts of the interruption unit 4, allows considerable advantages in terms of switching precision and speed. Alternatively, it is possible to use mechanical or hydraulic actuation means. Manual actuation

means can also be provided alternatively, or in addition, to the above described actuation means, particularly to perform emergency manual switching.

The device according to the invention can be of the type with single-pole actuation, in which actuation means are provided on each individual phase in order to perform switching for disconnection; alternatively, it can be of the type with three-pole actuation, in which the energy for switching for disconnection on the three phases of the device is provided by a single actuation means which is mechanically coupled to the disconnection units of each individual phase.

The gas-insulated switchgear device thus conceived is susceptible of numerous modifications and variations, all of which are within the scope of the inventive concept; all the details may furthermore be replaced with technically equivalent elements. In practice, the configurations considered, so long as they are compatible with the specific use, as well as the individual components, may be any according to the requirements and the state of the art.

CLAIMS

1. A gas-insulated switchgear device, having a first bushing which accommodates a first terminal and a second bushing which accommodates a second terminal, a first enclosure which contains an interruption unit, characterized in that it comprises at least one first disconnection unit which has a first fixed contact which is electrically connected to said interruption unit and a second fixed contact at ground voltage, a first moving contact which is electrically connected to the first terminal and can be coupled to said first and second fixed contacts, said moving contact being fixed to a rotary operating element and rotating rigidly therewith, and in that the fixed contacts that can be coupled to said first moving contact lie on the rotation plane of said moving contact.
2. The switchgear device according to claim 1, characterized in that said first disconnection unit comprises an enclosure which has a substantially spheroidal central portion and two mutually opposite ends which are structurally connected respectively to said first enclosure and to said first bushing.
3. The switchgear device according to claim 2, characterized in that said second fixed contact at ground voltage is arranged on the spheroidal portion.
4. The switchgear device according to claim 1, characterized in that the first moving contact is constituted by a blade which is keyed on said operating element and is substantially perpendicular to its rotation axis.
5. The switchgear device according to one or more of the preceding claims, characterized in that said first moving contact can be turned between a first position for coupling to the first fixed contact and a second position for coupling to the second fixed contact, the rotation angle between the first position and the second position being between 30° and 150°, preferably between 60° and 120°, more preferably between 80° and 100°.

6. The switchgear device according to one or more of the preceding claims, characterized in that the rotary operating element comprises a shaft made of insulating material, said shaft having an end which is connected to the first terminal and being suitable to support it structurally.

7. The switchgear device according to claim 1, characterized in that it comprises a second disconnection unit which is arranged inside said first enclosure and comprises a third fixed contact which is connected to the second terminal and a fourth fixed contact which is at ground voltage, at least one second moving contact which can be coupled to at least one of said third and fourth fixed contacts and is electrically connected to said interruption unit, said second moving contact being fixed to a second rotary operating element and rotating rigidly therewith, the fixed contact that can be coupled to said second moving contact being arranged on the rotation plane of said second moving contact.

8. The switchgear device according to claim 7, characterized in that said second disconnection unit comprises a single moving contact and in that said third and fourth fixed contacts lie on the rotation plane of the moving contact.

9. The switchgear device according to claim 7, characterized in that said second disconnection unit comprises a second moving contact and a third moving contact which are fixed to said second operating element, and in that said third and fourth fixed contacts lie respectively on the rotation plane of said second and third moving contacts, which are fixed to said second operating element in a relative angular arrangement by virtue of which they cannot be simultaneously coupled respectively to said third and fourth fixed contacts.

10. The switchgear device according to one or more of claims 7-9, characterized in that it comprises a third bushing which accommodates a third terminal and

in that said second disconnection unit comprises a fifth fixed contact which is connected to said third terminal, a second moving contact and a third moving contact which are fixed to the second operating element, said third and fourth fixed contacts being arranged on the rotation plane of said second moving contact, the fifth fixed contact being arranged on the rotation plane of said third moving contact, the second and third moving contacts being fixed to the second operating element in a mutual angular arrangement by virtue of which they cannot be simultaneously coupled respectively to said fourth and fifth fixed contacts.

11. The switchgear device according to one or more of claims 1 to 9, characterized in that it comprises a third bushing which accommodates a third terminal, and in that said second disconnection unit comprises a fifth fixed contact which is connected to said third terminal, a second moving contact, a third moving contact and a fourth moving contact which are fixed to the second operating element, the third, fourth and fifth fixed contacts being arranged respectively on the rotation plane of the second, third and fourth moving contacts, said moving contacts being fixed to the operating element in a mutual angular arrangement by virtue of which the third moving contact cannot be coupled to the fourth fixed contact when the second and/or fourth moving contacts are coupled to the corresponding fixed contacts.

12. The switchgear device according to one or more of claims 8 to 11, characterized in that at least one of the moving contacts that belong to the second disconnection unit is constituted by a blade which is keyed on the second operating element and is substantially perpendicular to the rotation axis of said second operating element.

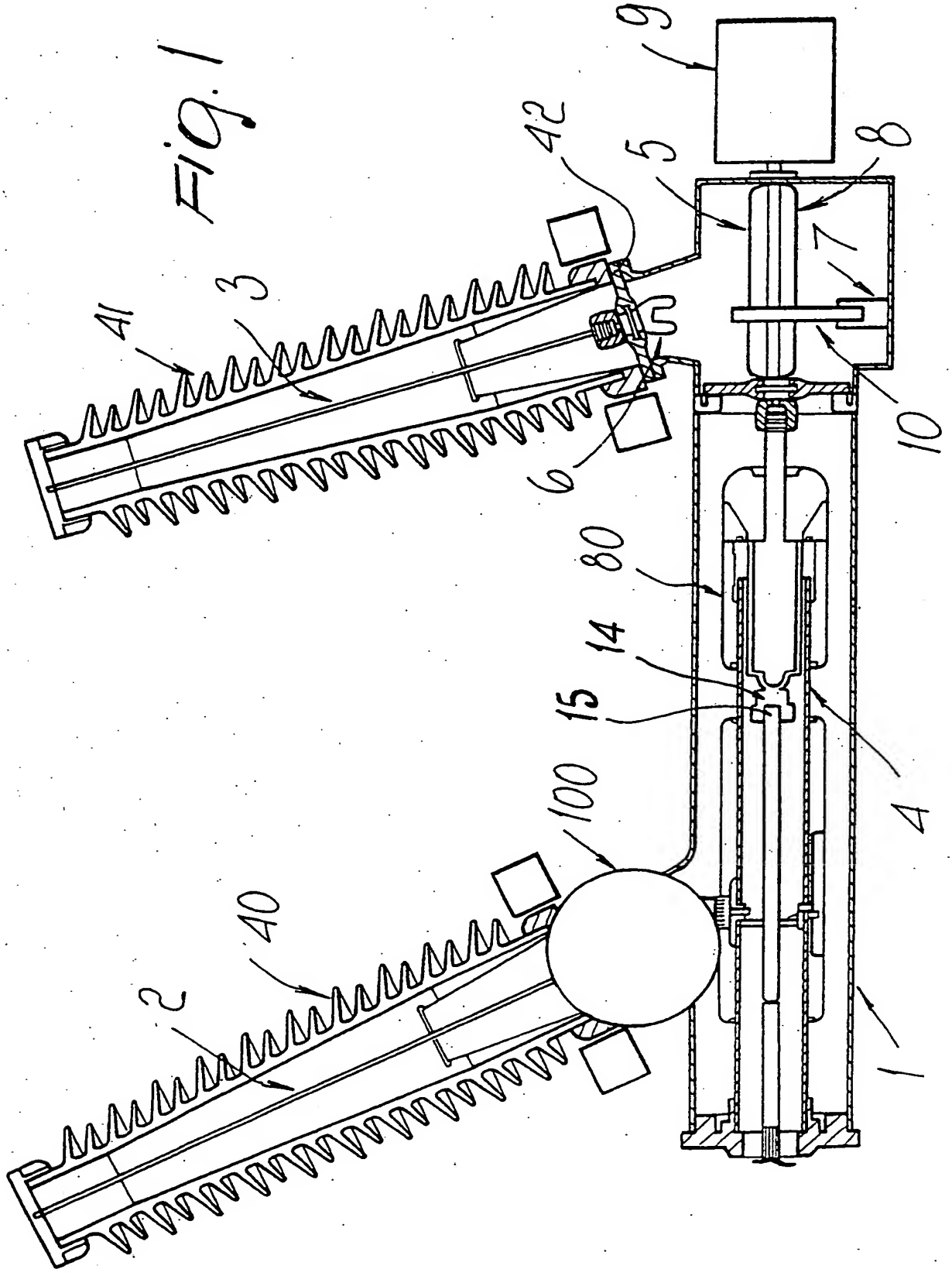
13. The switchgear device according to one or more of the preceding claims, characterized in that the interruption unit comprises an interruption chamber

which accommodates a fixed contact and a moving contact, the longitudinal axis of said chamber being substantially aligned with the rotation axis of the second operating element.

14. The switchgear device according to claim 13, characterized in that the enclosure of said interruption chamber constitutes the second operating element.

15. The switchgear device according to one or more of the preceding claims, characterized in that the rotary operating element of the first and/or the second disconnection units are actuated by an electric rotary servomotor.

Fig. 1



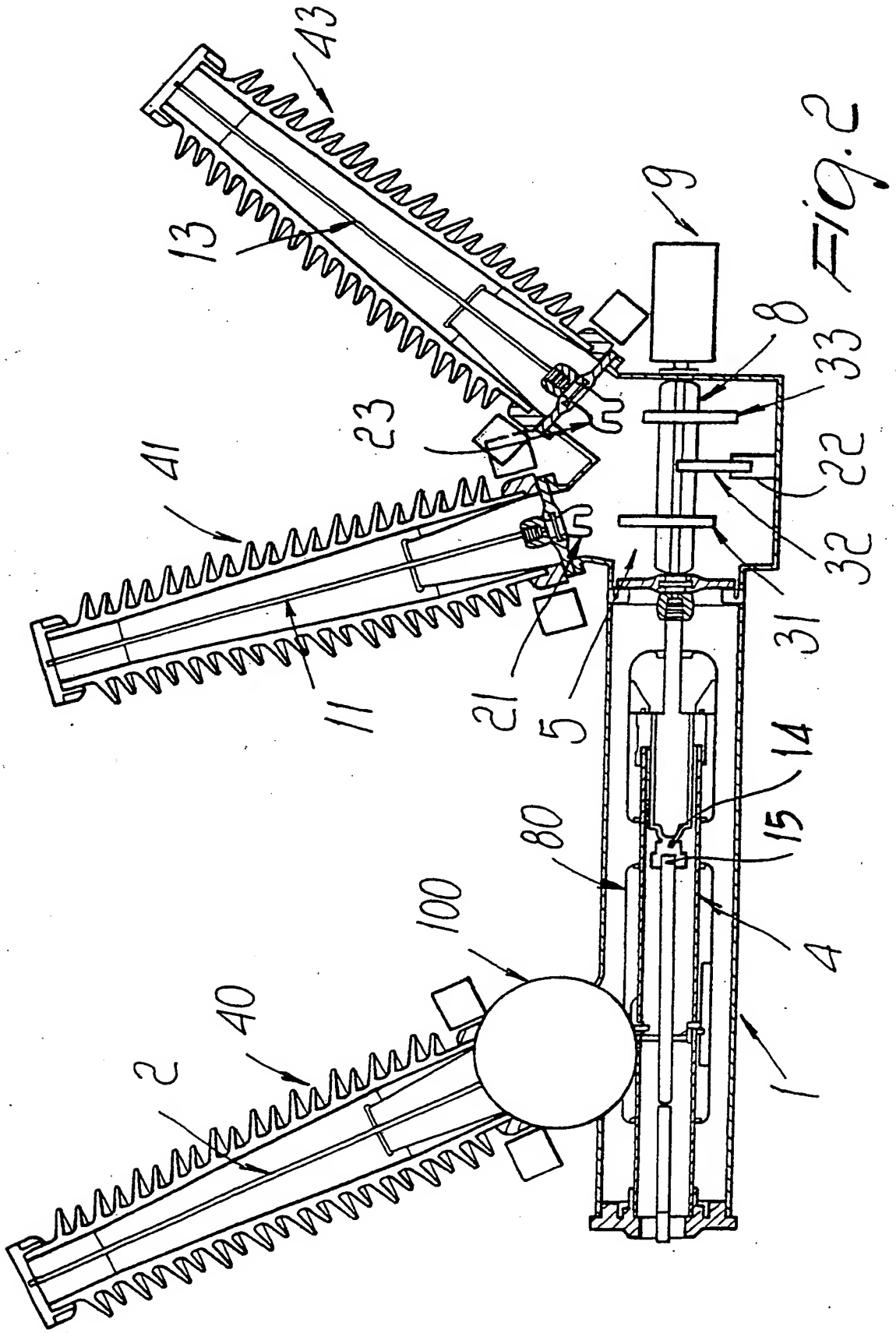


Fig. 2

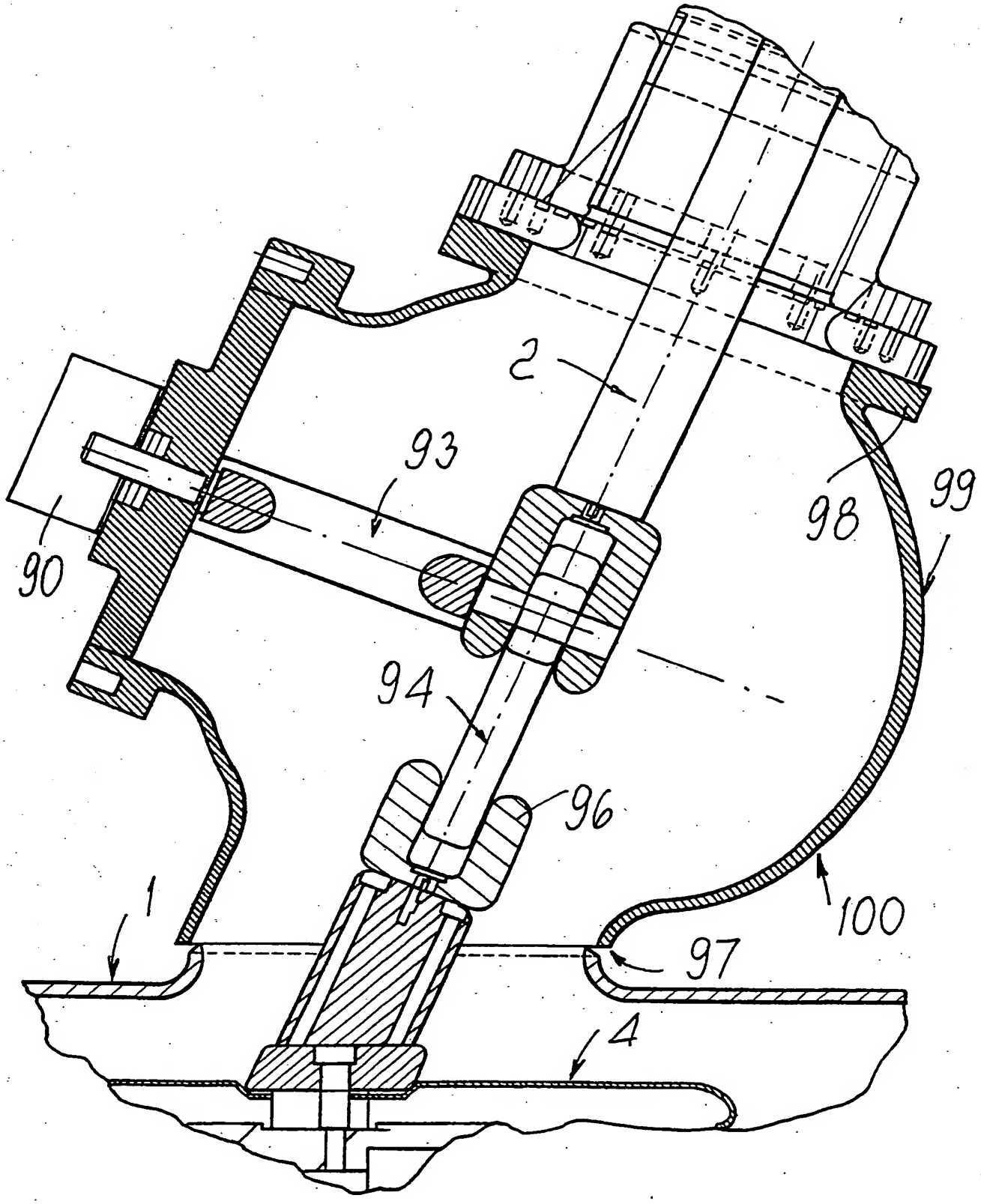


FIG. 3

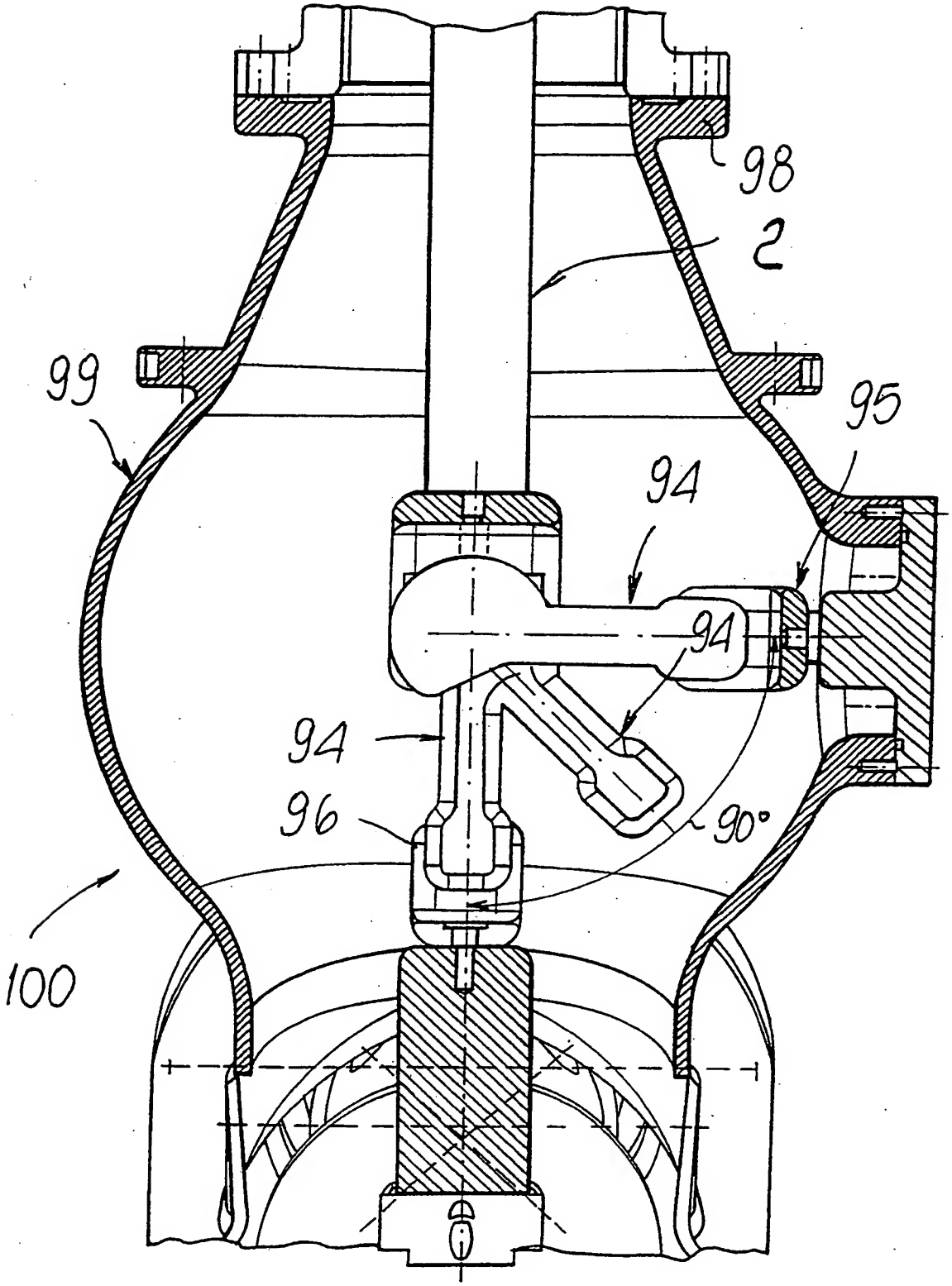


FIG. 4

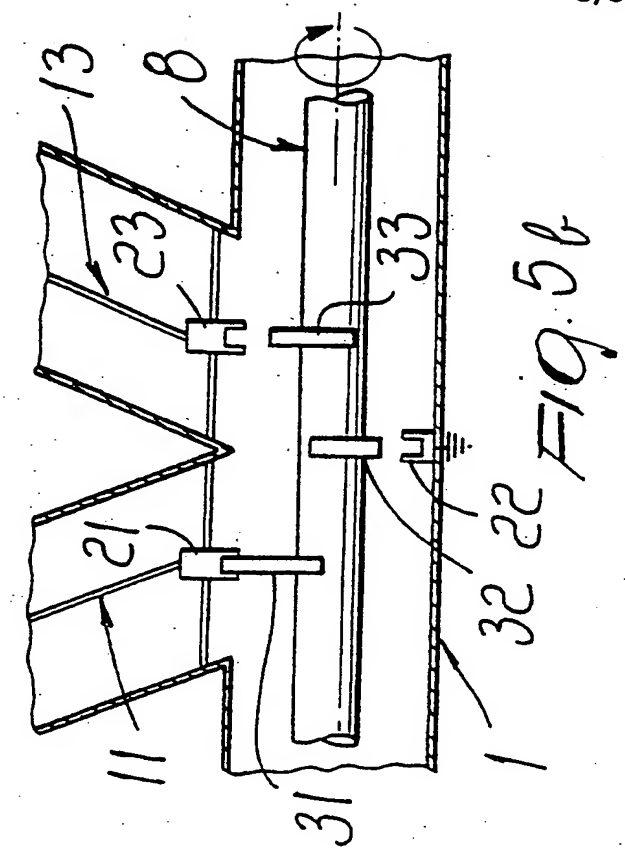


Fig. 5b

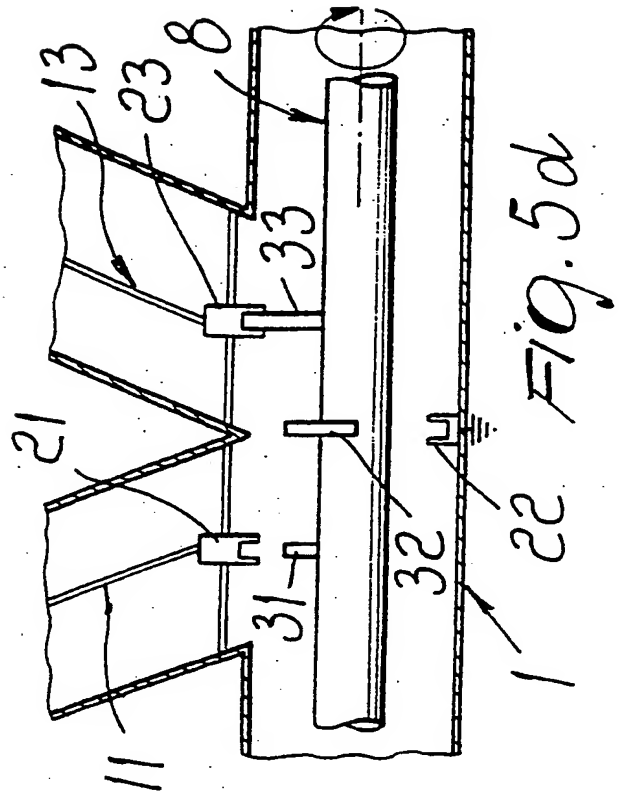


Fig. 5d

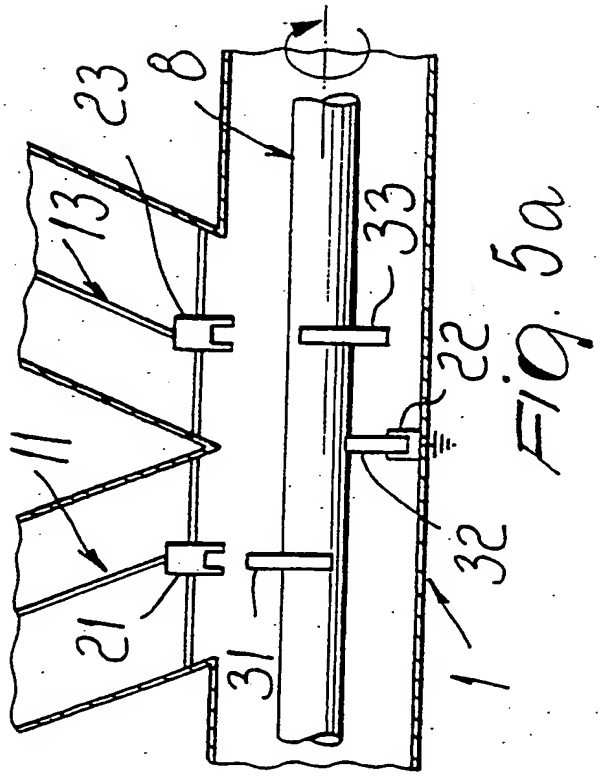


Fig. 5a

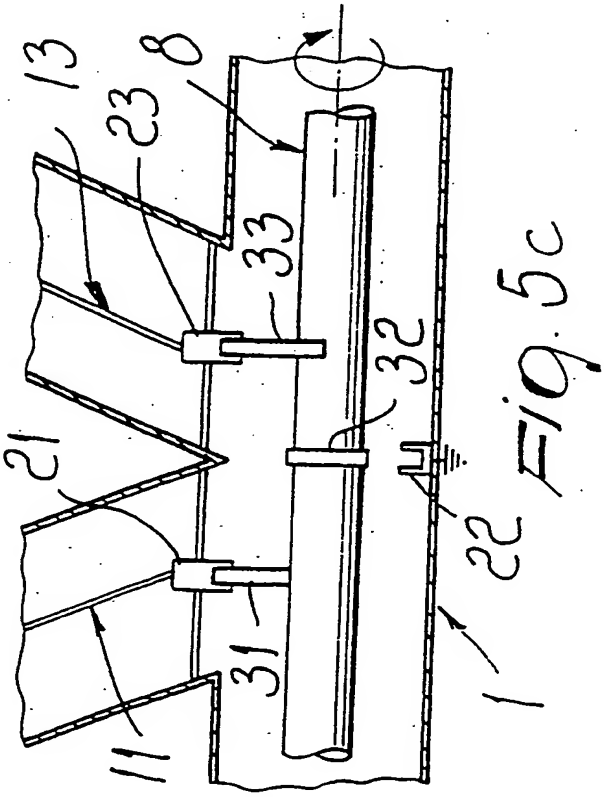


Fig. 5c

INTERNATIONAL SEARCH REPORT

Inter nal Application No
PCT/EP 00/08842

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 H02B13/035

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 H02B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y	DE 297 00 930 U (SIEMENS AG) 3 April 1997 (1997-04-03) page 1, line 20 -page 2, line 24 page 3, line 1 - line 16; figure	1-6 7,8, 12-15
Y	US 5 796 060 A (HOEGG PETER ET AL) 18 August 1998 (1998-08-18) column 6, line 53 -column 7, line 10; figures 1-6	7,8, 12-15
A	US 4 109 124 A (BOERSMA RINTJE ET AL) 22 August 1978 (1978-08-22) column 1, line 12 - line 53; figures.	2,3

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
22 December 2000	03/01/2001

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Castanheira Nunes, F

1

Form PCT/ISA/210 (second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

...formation on patent family members

Inte... ...onal Application No
PCT/EP 00/08842

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
DE 29700930 U	03-04-1997	NONE	
US 5796060 A	18-08-1998	DE 19511168 A	02-10-1996
		CA 2168637 A	29-09-1996
		CN 1140351 A	15-01-1997
		EP 0735637 A	02-10-1996
		JP 8275323 A	18-10-1996
US 4109124 A	22-08-1978	NL 7504130 A	11-10-1976
		AU 1251576 A	06-10-1977
		BE 839759 A	20-09-1976
		CA 1051072 A	20-03-1979
		CH 613804 A	15-10-1979
		DE 2615124 A	21-10-1976
		DE 7610865 U	21-10-1976
		FR 2307362 A	05-11-1976
		GB 1514137 A	14-06-1978
		IT 1060963 B	30-09-1982
		JP 51122776 A	27-10-1976
		SE 7603986 A	08-10-1976

Docket # 2004P00851

Applic. #

Applicant: Bausch, et al.

Lerner Greenberg Stemer LLP
Post Office Box 2480
Hollywood, FL 33022-2480
Tel: (954) 925-1100 Fax: (954) 925-1101